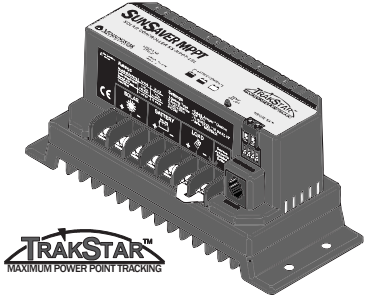
SUNSAVER MPPT™

WITH TRAKSTAR™ MPPT TECHNOLOGY

Installation and Operation Manual



Model: SS-MPPT-15L

MORNINGSTAR corporation

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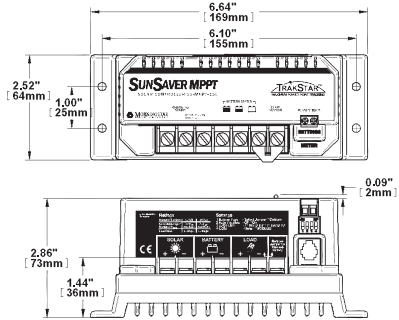
SunSaver MPPT Dimensions



Specification Summary

System Voltage	12 Volts / 24 Volts
Rated Battery Current	15 Amps
Rated Load Current	15 Amps
Max. Input Voltage**	75 Volts
Nominal Input Power	
12 Volt System	200 Watts
24 Volt System	400 Watts

see Section 7.0 for full technical specifications

*** Array voltage should never exceed maximum input voltage. Refer to the solar module documentation to determine the highest expected array V_{oc} as defined by the lowest expected ambient temperature for the system location.*

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1.0 Important Safety Information

Save These Instructions

This manual contains important safety, installation and operating instructions for the SunSaver MPPT solar controller.

The following symbols are used throughout this manual to indicate potentially dangerous conditions or mark important safety instructions.

WARNING: Indicates a potentially dangerous condition. Use extreme caution when performing this task.

CAUTION: Indicates a critical procedure for safe and proper operation of the controller.

NOTE: Indicates a procedure or function that is important for the safe and proper operation of the controller.

General Safety Information

- Read all of the instructions and cautions in the manual before beginning installation.
- There are no user serviceable parts inside the SunSaver MPPT. Do not disassemble or attempt to repair the controller.
- Disconnect all sources of power to the controller before installing or adjusting the SunSaver MPPT.
- There are no fuses or disconnects inside the SunSaver MPPT. Install external fuses/breakers as required.
- Do not allow water to enter the controller.
- Confirm that power connections are tightened to avoid excessive heating from a loose connection.

2.0 General Information

2.1 Overview

Thank you for selecting the SunSaver MPPT charge controller with *TrakStar Technology*™. The SunSaver MPPT (SS-MPPT) is an advanced maximum power point tracking solar battery charger and load controller for stand-alone PV systems. The controller features a smart tracking algorithm that maximizes the energy from the solar module(s) and also provides load control to prevent over-discharge of the battery.

The SS-MPPT battery charging process has been optimized for long battery life and improved system performance. Self-diagnostics and electronic error protection prevent damage when installation mistakes or system faults occur. The controller also features four (4) settings switches for adjustability, a meter port, and terminals for remote battery temperature measurement (optional).

Although the SS-MPPT is very simple to configure and use, please take the time to read this operator's manual and become familiar with the controller. This will help you make full use of the many advantages the SS-MPPT can provide for your PV system.

The features of the SunSaver MPPT are shown in Figure 1 below. An explanation of each feature is provided.

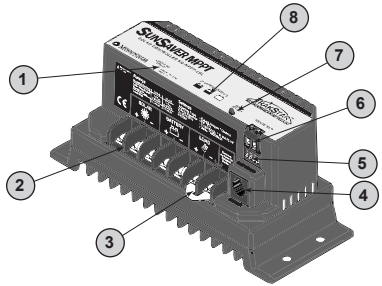

Figure 1. SunSaver MPPT features.

1 - Status LED

An LED indicator that shows charging status and also indicates when a solar input fault condition exists.

2 - Power Terminal Block

Power terminations for system Solar, Battery, and Load connections.

3 - Battery Select Jumper

A removable jumper to select the battery type.

4 - Meter Connection

A communication port for the Morningstar *Remote Meter* or Personal Computer (PC) connection. A *MSC* adapter is required, available separately.

5 - Settings Switches

Adjustment switches that define the operating parameters of the SunSaver MPPT.

6 - Remote Temperature Sensor (RTS) Terminals

Connection point for a Morningstar RTS (optional) to remotely monitor battery temperature.

7 - Local Temperature Sensor

Measures ambient temperature. Battery regulation is adjusted based on ambient temperature unless an optional RTS is installed.

8 - Battery Status LEDs

Provides approximate battery *state of charge* indication and also indicates when a system or load fault condition exists.

2.3 Optional Accessories

The following accessories are available for purchase separately from your authorized Morningstar dealer.

Remote Temperature Sensor (Model: RTS)

The RTS measures battery temperature for accurate temperature compensation and is recommended when the ambient battery temperature differs from the ambient controller temperature by +/- 5 degrees C or more. An RTS can be attached to the SunSaver MPPT at any time. The SunSaver MPPT will automatically use the RTS for battery temperature compensation when installed. The standard cable length is 33 ft (10 m), and can be extended to 100 ft (30 m) if required. Installation instructions are provided with the RTS.

Remote Meter (Model: RM-1)

The digital *Remote Meter* displays system operating information, error indications, and self-diagnostic read-out. Information is displayed on a backlit 4-digit custom LCD display. The large numerical display and icons are easy to read and large buttons make navigating the meter menus easy. Additionally, a status LED and three (3) battery SOC LEDs provide system status at a glance.

The meter can be flush mounted in a wall or surface mounted using the mounting frame (included). The RM-1 is supplied with 33 ft (10.0 m) of cable, a mounting frame, and mounting screws. The RM-1 connects to the RJ- 11 Meter port on the SunSaver MPPT.

PC MeterBus Adapter™ (Model: MSC)

The *MSC* converts the MeterBus RJ-11 electrical interface to an isolated standard RS-232 interface which enables communication between the SunSaver MPPT and a personal computer (PC). The *MSC* is required for programming custom charging setpoints and for logging data. See *Section 4.7 Programming Custom Setpoints* or visit Morningstar's website for more information.

3.0 Installation Instructions

3.1 General Installation Notes

- Read through the entire installation section first before beginning installation.
- Be very careful when working with batteries. Wear eye protection. Have fresh water available to wash and clean any contact with battery acid.
- Use insulated tools and avoid placing metal objects near the batteries.
- Explosive battery gasses may be present during charging. Be certain there is sufficient ventilation to release the gasses.
- Do not install in locations where water can enter the controller.
- Loose power connections and/or corroded wires may result in resistive connections that melt wire insulation, burn surrounding materials, or **even cause fire**. Ensure tight connections and use cable clamps to secure cables and prevent them from swaying in mobile applications.
- Only charge lead-acid or NiCd batteries.
- The SunSaver MPPT Battery connection may be wired to one battery or a bank of batteries. The following instructions refer to a singular battery, but it is implied that the battery connection can be made to either one battery or a group of batteries in a battery bank.

3.2 Configuration

The four (4) *Settings Switches* and the B*attery Select Jumper* adjust the SS-MPPT battery type, load control, equalization, and communication settings. This section details the configuration for each setting.

Select a Battery Type

The SS-MPPT provides four (4) different battery types as shown in table 1 below. Use *Settings Switch* 1 and the *Battery Select Jumper* to choose the battery type. See *Section 7.0 Technical Specifications* for detailed charging information for each battery type.

The battery select jumper is secured in the terminal block between terminal #6 and terminal #7 as shown in figure 2. The second column in table 1 specifies whether the jumper should be removed or remain in place, depending on the desired battery type.

Battery Type	Battery Jumper	Switch 1
Gel[1]	INSERTED	ON (↑)
Sealed	INSERTED	OFF (↓)
AGM[1]	REMOVED	ON (↑)
Flooded	REMOVED	OFF (↓)

(1) Setpoints for this battery type can be modified with custom programming. See *Section 4.7 Programming Custom Setpoints* for more information.

Table 1. Battery Type selection

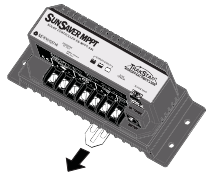

Figure 2. Removing the Battery Select jumper.

Load Control – Low Voltage Disconnect / Reconnect

Choose between two (2) load control *Low Voltage Disconnect* / *Reconnect* settings.

SWITCH 2 OFF (↓): LVD = 11.50 V, LVR = 12.60 V
SWITCH 2 ON (↑): LVD = 11.00 V, LVR = 12.10 V [2]

(2) These values can be modified with custom programming. See *Section 4.7 Programming Custom Setpoints* for more information.

Enable or Disable Auto-Equalization

Turn the auto-equalize feature OFF or ON. The auto-equalize feature will administer an equalization charge (flooded battery type only) every 28 days or if the battery discharges too low the previous night. There is no equalization charge for the gel or sealed battery type.

SWITCH 3 OFF (↓): AUTO-EQUALIZE OFF

SWITCH 3 ON (↑): AUTO-EQUALIZE ON
(agm, *flooded* battery type only)

Communication – Meter / MODBUS®

Choose the desired communication protocol for the RJ-11 meter connection. Select the *Meter* protocol to communicate with a Morningstar Remote Meter (optional accessory).

Select the *MODBUS®* protocol to communicate with a PC[2] and Morningstar's MSView software. *MODBUS®* is an open communication protocol standard used by Morningstar's MSView PC software and other 3rd party hardware / software.

SWITCH 4 OFF (↓):	MORNINGSTAR REMOTE METER
SWITCH 4 ON (↑):	MODBUS® PROTOCOL FOR MSVIEW, 3RD PARTY DEVICES

(2) Morningstar PC Meterbus Adapter (Model: MSC) required. Not included. See Morningstar's website for more information. www.morningstarcorp.com.

MODBUS® is a registered trademark of Modbus-IDA (www.modbus-ida.org)

3.3 Mounting

NOTE: When mounting the SunSaver MPPT, ensure free air flow through the controller heat sink fins. There should be at least 6 inches (150 mm) of clearance above and below the controller to allow for cooling. If mounted in an enclosure, ventilation is highly recommended.

WARNING: Risk of explosion! Never install the SunSaver MPPT in a sealed enclosure with vented (flooded) batteries! Do not install in a confined area where battery gasses can accumulate.

3.0

Step 1: Choose Mounting Location

Locate the SunSaver MPPT on a vertical surface protected from direct sun, high temperatures, and water.

Step 2: Check for Clearance

Place the SunSaver MPPT in the location where it will be mounted. Verify that there is sufficient room to run wires and that there is ample room above and below the controller for air flow.

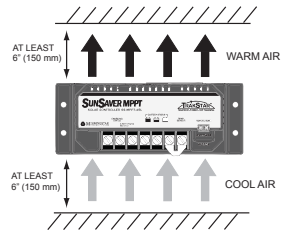

Figure 3. Mounting and cooling

Step 3: Mark Holes

Use a pencil or pen to mark the four (4) mounting hole locations on the mounting surface.

Step 4: Drill Holes

Remove the controller and drill 3/32” (2.5 mm) holes in the marked locations.

Step 5: Secure Controller

Place the controller on the surface and align the mounting holes with the drilled holes in step 4. Secure the controller in place using the mounting screws (included).

3.4 Wiring

NOTE: A recommended connection order has been provided for maximum safety during installation. The controller will not be damaged regardless of the sequence of connnections.

NOTE: The SS-MPPT is a negative ground controller. Any combination of negative connections can be earth grounded as required. Grounding is recommended, but not required for correct operation.

CAUTION: The total current draw of all system loads connected to the SS-MPPT LOAD terminals cannot exceed the 15A load current rating.

CAUTION: For mobile applications, be sure to secure all wiring. Use cable clamps to prevent cables from swaying when the vehicle is in motion. Unsecured cables create loose and resistive connections which may lead to excessive heating and/or fire.

Step 1: Load Wiring

The SS-MPPT load output connection will provide battery voltage to system loads such as lights, pumps, motors, and electronic devices. See *Section 4.4 Load Control Information* for more details about load control.

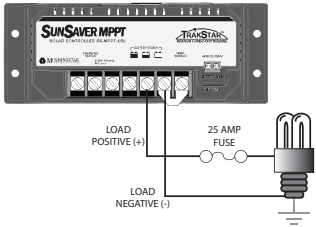

Figure 4. Load wiring

Connect load positive (+) and negative (-) load wires to the system load(s) or load distribution panel as shown in figure 4. Refer to the wire gauge chart on page 41 of this manual for correct wire size.

If required, the negative load connection may be earth grounded. Use appropriate gauge wire and proper grounding methods for the installation site.

An in-line fuse holder should be wired in series in the load positive (+) wire as shown. DO NOT INSERT A FUSE AT THIS TIME.

If wiring the load connection to a load distribution panel, each load circuit should be fused separately. The total load draw should not exceed the 15 A load rating

Step 2: Battery Wiring

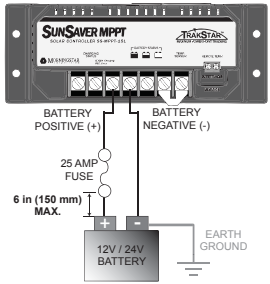

Figure 5. Battery wiring.

Before connecting the battery, measure the battery voltage. It must be over 7 volts to power the controller. For 24 volt systems, the battery voltage must be greater than 15.5 volts to properly detect a 24V battery. The 12/24 volt battery detection is automatic and the check is only performed at start-up.

Connect the battery to the SS-MPPT. Refer to the wire gauge chart on page 41 of this manual for correct wire size.

If required, the negative battery connection may be earth grounded. Use appropriate gauge wire and proper grounding methods for the installation site.

Wire an in-line fuse holder no more than 6 inches (150 mm) from the battery positive terminal. DO NOT INSERT A FUSE AT THIS TIME.

Step 3: Solar Wiring

WARNING: Risk of electric shock! Exercise caution when handling solar wiring. The solar array high voltage output can cause severe shock or injury. Cover modules from the sun before installing solar wiring.

The SunSaver MPPT can accept 12 V , 24 V, or 36 V nominal off-grid solar module arrays. Grid-tie solar module(s) may be used if the open circuit voltage (V_{OC}) does not exceed the SS-MPPT 75 Volt maximum solar input rating. The solar module(s) nominal voltage must be equal to or greater than the nominal battery voltage. For 24 V systems, a 24 V or 36 V nominal solar array must be used.

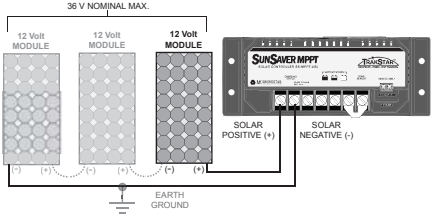

Figure 6. Solar input wiring.

Connect the solar module(s) to the SS-MPPT. Refer to the wire gauge chart on page 41 of this manual for correct wire size.

If required, the negative solar connection may be earth grounded. Use appropriate gauge wire and proper grounding methods for the installation site.

Step 4: Accessories (optional)

Install the *Remote Temperature Sensor* and *Remote Meter* (both purchased separately) if required. Refer to the instructions provided with each accessory for detailed installation procedures.

Step 5: Confirm Wiring

Double-check the wiring in steps 1 through 4. Confirm correct polarity at each connection. Verify that all seven (7) SS-MPPT power terminals are tightened.

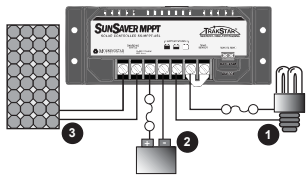

Figure 7. System Wiring Review

Step 6: Install Fuses

Install a 25 Amp DC-rated fuse in each fuse holder in the following order:

1. Load circuit
2. Battery circuit

Step 7: Confirm Power-up

The SS-MPPT should begin the power-up LED sequence when battery power is applied. Observe that the Battery Status LEDs blink in sequence one time.

If the SS- MPPT does not power up or a flashing LED error sequence exists, refer to *Section 6.0 Troubleshooting.*

4.1 LED Indications

STATUS LED

The Status LED indicates charging status and any existing solar input error conditions. The Status LED is on when charging during the day and off at night. The Status LED will flash red whenever an error condition(s) exists. Table 2 lists the Status LED indications.

Color	Indication	Operating State
None	Off (with heartbeat[1])	Night
Green	On Solid (with heartbeat[2])	Charging
Red	Flashing	Error
Red	On Solid (with heartbeat[2])	Critical Error

[1] heartbeat indication flickers the Status LED on briefly every 5 seconds
[2] heartbeat indication flickers the Status LED off briefly every 5 seconds

Table 2. Status LED definitions

For more information on Status LED errors, see *Section 5.1 Error Indications*.

BATTERY SOC LEDS

Three (3) battery "state of charge" LEDs indicate the level of charge on the battery. The SOC indication is based on battery voltage setpoints alone, which only provides an approximation of the actual state of charge of the battery.

Table 3 lists the SOC LED indications.

SOC LED	Indication	Battery Status	Load Status
Green	Fast Flashing (2 Flash / sec)	Equalize Charge	Load On
Green	Med. Flashing (1 Flash / sec)	Absorption Charge	Load On
Green	Slow Flashing (1 Flash / 2 sec)	Float Charge	Load On
Green	On solid	Nearly Full	Load On
Yellow	On solid	Half Full	Load On
Red	Flashing (1 Flash / sec)	Battery Low	LVD Warning (Load On)
Red	On solid	Battery Empty	LVD (Load Off)

Table 3. Battery SOC LED definitions

CAUTION: An error condition exists if multiple Battery SOC LEDs are flashing. See Section 5.1 Error Indications for more information.

4.2 TrakStar™ MPPT Technology

The SS-MPPT utilizes Morningstar's TrakStar Maximum Power Point Tracking technology to extract maximum power from the solar module(s). The tracking algorithm is fully automatic and does not require user adjustment. Trakstar technology will track the array *maximum power point voltage* (V_{mp}) as it varies with weather conditions, ensuring that maximum power is harvested from the array through the course of the day.

Current Boost

In many cases, TrakStar MPPT technology will "boost" the solar charge current. For example, a system may have 2 Amps of solar current flowing into the SS-MPPT and 5 Amps of charge current flowing out to the battery. The SS-MPPT does not create current! Rest assured that the power into the SS-MPPT is the same as the power out of the SS-MPPT. Since power is the product of voltage and current (Volts x Amps), the following is true*:

(1) Power Into the SS-MPPT = Power Out of the SS-MPPT
(2) Volts In x Amps In = Volts Out x Amps Out

* assuming 100% efficiency. losses in wiring and conversion exist.

If the solar module's V_{mp} is greater than the battery voltage, it follows that the battery current must be proportionally greater than the solar input current so that input and output power are balanced. The greater the difference between the maximum power voltage and battery voltage, the greater the current boost. Current boost can be substantial in systems where the solar array is of a higher nominal voltage than the battery as described in the next section.

High Voltage Strings and Grid-tie Modules

Another benefit of TrakStar MPPT technology is the ability to charge 12 Volt or 24 Volt batteries with solar arrays of higher nominal voltages. A 12V battery bank can be charged with a 12 V, 24 V, or 36 V nominal off-grid solar array. Certain grid-tie solar modules may also be used as long as the solar array *open circuit voltage* (V_{oc}) rating will not exceed the SS-MPPT 75 V maximum input voltage rating at worst-case (coldest) module temperature. The solar module documentation should provide V_{oc} vs. temperature data.

Higher solar input voltage results in lower solar input current for a given input power. High voltage solar input strings allow for smaller gauge solar wiring. This is especially helpful for systems with long wiring runs between the solar array and the SS-MPPT.

An Advantage Over Traditional Controllers

Traditional controllers connect the solar module directly to the battery when recharging. This requires that the solar module operate in a voltage range that is below the module's V_{mp}. In a 12 V system for example, the battery voltage may range from 10 - 15 Vdc but the module's V_{mp} is typically around 17 V. Figure 8 shows a typical current vs. voltage output curve for a nominal 12V off-grid module.

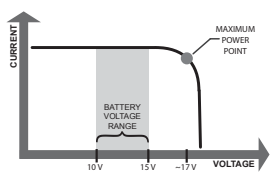

Figure 8. Nominal 12 V Solar Module I-V curve

The array V_{mp} is the voltage where the product of current and voltage (Amps x Volts) is greatest, which falls on the “knee” of the solar module I-V curve as shown in Figure 8.

Because Traditional controllers do no operate at the V_{mp} of the solar array, energy is wasted that could otherwise be used to charge the battery and power system loads. The greater the difference between battery voltage and the Vmp of the module, the more energy is wasted.

TrakStar MPPT technology will always operate at the V_{mp} resulting in less wasted energy compared to traditional controllers.

4.3 Battery Charging Information

The SunSaver MPPT has a 4-stage battery charging algorithm for rapid, efficient, and safe battery charging. Figure 9 shows the sequence of the stages.

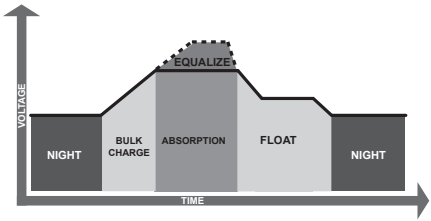

Figure 9. SunSaver MPPT charging algorithm

Bulk Charge

In this stage, the battery voltage has not yet reached absorption voltage and 100% of available solar power is used to recharge the battery.

Absorption

When the battery has recharged to the Absorption voltage setpoint, constant-voltage regulation is used to prevent heating and excessive battery gassing.

Float

After the battery is fully charged the SS-MPPT reduces the battery voltage to a float charge which is sometimes called a *trickle charge.*

Depending on battery history, the battery remains in the

absorption stage for 3 or 4 hours before transitioning to the float stage.

Equalize (flooded battery type only)

If the auto-equalize feature is enabled, the SS-MPPT will equalize a flooded battery for three (3) hours every 28 days. Equalize charging raises the battery voltage above the standard absorption voltage so that the electrolyte gasses. This process prevents electrolyte stratification and equalizesthe individual cell voltages within the battery.

4.4 Load Control Information

The primary purpose of the load control function is to disconnect system loads when the battery has discharged to a low state of charge and reconnect system loads when the battery is sufficiently recharged. System loads may be lights, pumps, motors, DC appliances, and other electronic devices. The total current draw of all loads must not exceed the SS-MPPT 15 Amp maximum load rating.

CAUTION: Do not wire an AC inverter of any size to the load terminals of the SunSaver MPPT. Damage to the load control circuit may result. Wire inverters directly to the battery or battery bank.

Load Control Settings

Load control is fully automatic. Choose between two (2) factory Low Voltage Disconnect (LVD) and Low Voltage Reconnect (LVR) settings by adjusting switch #2. See *Section 3.2 Configuration* for more information.

Current Compensation

All LVD and LVR setpoints are current compensated. Under load the battery voltage will sag in proportion to the current draw of the load. A short-term large load could cause a premature LVD without the current compensation feature. LVD and LVR setpoints are adjusted lower per the following table.

System Voltage	Current Compensation
12 Volt	-15 mV per amp of load
24 Volt	-30 mV per amp of load

Table 4. Current compensation values.

LVD Warning

As the battery discharges the *Battery Status* LEDs will transition from green to yellow and then from yellow to flashing red. The flashing red indication is a warning that a low voltage disconnect event will occur soon. The amount of time between a green SOC indication and load disconnect will depend on many factors including:

- rate of discharge (amount of load draw)
- capacity of the battery
- health of the battery
- LVD setpoint

If the battery discharges to the LVD setpoint the load will disconnect and a solid red Battery Status LED indication will be displayed.

General Load Control Notes

- A 15 V maximum regulation voltage limit (30 V @ 24 V nominal) exists for all battery types. This limit ensures that the battery and load terminal voltages will never exceed 15 V/30 V. This protects certain DC loads that may be damaged by high input voltage.
- Do not wire multiple SunSaver MPPT load outputs together in parallel to power DC loads with a current draw greater than 15A. Equal current sharing cannot be guaranteed and an over-load condition will likely occur on one or more controllers.
- Exercise caution when connecting loads with specific polarity to a live load circuit. A reverse polarity connection may damage the load. Always double check load connections before applying power.

4.5 Protections

Solar Overload

(No LED indication) The SunSaver MPPT will limit battery current to the 15 Amp maximum rating. An over-sized solar array will not operate at peak power. The solar array should be less than the SS-MPPT *nominal max. input power rating* for optimal performance. See *Section 7.0 Technical Specifications* for more information.

Load Overload

(Battery Status LEDs: R/Y-G sequencing) If the load current exceeds the maximum load current rating, the SS-MPPT will disconnect the load. The greater the overload the faster the load will be disconnected. A small overload could take a few minutes to disconnect.

The SS-MPPT will attempt to reconnect the load two (2) times. Each attempt is approximately 10 seconds apart. If the overload remains after two (2) attempts, the load will remain disconnected until power is removed and reapplied.

Solar Short Circuit

(Charging Status LED: OFF) Solar input power wires are short-circuited. Charging automatically resumes when the short is cleared.

Load Short Circuit

(Battery Status LEDs: R/Y-G sequencing) Fully protected against load wiring short-circuits. After two (2) automatic load reconnect attempts (10 seconds between each attempt), the fault must be cleared by removing and reapplying power.

High Voltage Input

(Charging Status LED: R flashing) If the solar input open circuit voltage (V_{oc}) exceeds the 75 volt maximum rating the array will remain disconnected until the V_{oc} falls safely below the maximum rating.

Battery Reverse Polarity

(No LED indication, not powered) Fully protected against reverse battery connection. No damage to the controller will result. Correct the miswire to resume normal operation.

Damaged Local Temperature Sensor

(Charging Status LED: R on solid) The local ambient temperature sensor is short-circuited or damaged. Charging stops to avoid over- or under-charging. This is a critical error. Contact your authorized Morningstar dealer for service.

Damaged Internal Temperature Sensor

(Charging Status LED: R on solid) The internal heatsink temperature sensor is damaged. This is a critical error. Contact your authorized Morningstar dealer for service.

High Temperature

(Battery Status LED: R-Y sequencing) The heatsink temperature has exceeded safe limits and the load is disconnected. The load will automatically reconnect when the heatsink cools to a safe temperature.

Remote Temperature Sensor (RTS)

(Battery Status LED: R/Y - G/Y sequencing) A bad RTS connection or a severed RTS wire has disconnected the temperature sensor during charging. Charging automatically resumes when the problem is fixed. To resume operation without a RTS, disconnect all power to the SunSaver MPPT and then reconnect.

High Voltage Transients

Solar, battery, and load power connections are protected against high voltage transients. In lightning prone areas, additional external suppression is recommended.

4.6 Inspection and Maintenance

The following inspections and maintenance tasks are recommended at least two times per year for best controller performance.

- Tighten all terminals. Inspect for loose, broken, or corroded connections.
- Verify that all wire clamps and tie-downs are secure.
- Check that the controller is mounted in a clean, protected environment; free of dirt, insects, nests, and corrosion.
- If applicable, check enclosure ventilation and air flow holes for obstructions.
- Verify LED indication is consistent with the present system conditions.
- Verify that the Remote Temperature Sensor (if used) is securely attached to the RTS terminals.

4.7 Programming Custom Setpoints

CAUTION: This feature should only be used by advanced users who have very specific charging and/or load control requirements that are not met using the factory default charge and load control settings. The factory default settings will be sufficient for the vast majority of users.

Custom charging and load setpoints can be programmed into SS-MPPT non-volatile memory using a PC with Morningstar *MSView* software installed and a *Meterbus to Serial Adapter* (model: MSC). Refer to the *MSView* help files for detailed instructions. *MSView* PC software is available for free on our website at:

http://www.morningstarcorp.com/

A setup wizard will guide you through the setpoint configuration process. Refer to MSView help files for more information.

To use custom setpoints, the Settings Switches must be adjusted as follows:

SWITCH #1 ON (↑) TO USE CUSTOM CHARGING SETPOINTS. USE THE BATTERY SELECT JUMPER TO SELECT BETWEEN TWO SETS OF CUSTOM CHARGING SETPOINTS.

SWITCH #2 ON (↑) TO USE CUSTOM LOAD CONTROL SETPOINTS.

NOTE: Programming custom setpoints will overwrite the default Gel and AGM battery type values programmed into custom memory at the factory. Document the new custom values in this manual for future reference.

5.1 Error Indications

NOTE: If an optional Morningstar Remote Meter is attached to the SunSaver MPPT , use the self-diagnostic feature to determine the cause of the error indication. Refer to the Remote Meter Operator's Manual for more information.

Status LED Error Indications

• PV High Voltage Disconnect	Flashing Red
• RTS Shorted	Flashing Red
• RTS Disconnected	Flashing Red
• Damaged local temp. sensor	Solid Red[1]
• Damaged heatsink temp. sensor	Solid Red[1]
• Damaged input MOSFETs	Solid Red[1]
• Firmware Error	Solid Red[1]

1 - heartbeat indication flickers the Status LED off briefly every 5 seconds

Battery Status LED Error Indications

• Load High Voltage Disconnect	R-G Sequencing
• High Temperature Disconnect	R-Y Sequencing
• Remote Temp. Sensor Error	Y/R - G/Y Sequencing
• External Wiring Error	G/R-Y Sequencing
• Load Overcurrent	Y/R-G Sequencing
• Load Short Circuit	G/R-Y Sequencing
• Custom Setpoints Update	G/Y/R Flashing
• Self-test Error	R-Y-G Sequencing

5.2 Common Problems

Problem: No LED indications
Solution: With a multi-meter, check the voltage at the battery terminals on the SS-MPPT. Battery voltage must be at least 7V to power the SS-MPPT.

Problem: The SS-MPPT is not charging the battery.
Solution: If the Status LED is solid or flashing red, see *Section 5.1 Error Indications*. If the Status LED is off, measure the voltage across the Solar input terminals of the SS-MPPT. Input voltage must be greater than battery voltage. Check fuses and solar wiring connections. Check solar array for shading.

Full testing documentation is available on our website at:

http://support.morningstarcorp.com/

6.0 Warranty

The SunSaver MPPT charge controller is warranted to be free from defects in material and workmanship for a period of FIVE (5) years from the date of shipment to the original end user. Morningstar will, at its option, repair or replace any such defective products.

CLAIM PROCEDURE

Before requesting warranty service, check the Operator's Manual to be certain that there is a problem with the controller. Return the defective product to your authorized Morningstar distributor with shipping charges prepaid. Provide proof of date and place of purchase.

To obtain service under this warranty, the returned products must include the model, serial number and detailed reason for the failure, the module type, array size, type of batteries and system loads. This information is critical to a rapid disposition of your warranty claim.

Morningstar will pay the return shipping charges if the repairs are covered by the warranty.

WARRANTY EXCLUSIONS AND LIMITATIONS

This warranty does not apply under the following conditions:

- Damage by accident, negligence, abuse or improper use.
- PV or load currents exceeding the ratings of the product.
- Unauthorized product modification or attempted repair.
- Damage occurring during shipment.

THE WARRANTY AND REMEDIES SET FORTH ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHERS, EXPRESS OR IMPLIED. MORNINGSTAR SPECIFICALLY DISCLAIMS ANY AND ALL IMPLIED WARRANTIES, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. No Morningstar distributor, agent or employee is authorized to make any modification or extension to this warranty.

MORNINGSTAR IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DOWNTIME, GOODWILL OR DAMAGE TO EQUIPMENT OR PROPERTY.

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Washington Crossing, PA 19877 USA
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Website: www.morningstarcorp.com

7.0 Technical Specifications

Electrical

Nominal system voltage	12 or 24 Vdc
Max. battery current	15 A
Battery voltage range	7 V – 36 V
Max. solar input voltage	75 V
Nominal Max. Input Power	
12 Volt	200 Watts
24 Volt	400 Watts
Self-consumption	35 mA
Accuracy	
Voltage	1.0 %
Current	2.0 %
Meter Connection	6-pin RJ-11
Transient Surge Protection	4 x 1500 W

Battery Charging

Regulation Method	4 stage
Temp. Compensation Coefficient	-5 mV / °C / cell (25°C reference)
Temp. Compensation Range	- 30°C to + 60°C
Temp. Compensated Setpoints	Absorption Float Equalize

Battery Status LEDs

	Falling V	Rising V	
G to Y	12.1	13.1	Y to G
Y to Flash R	11.7	12.6	Flash R to Y
Flash R to R	11.5	12.6	R to Y

Note: Multiply x2 for 24 Volt systems.

Battery Setpoints (@ 25°C)

	Gel	Sealed	AGM	Flooded
Absorption Voltage	14.0 V	14.1 V	14.3 V	14.4 V
Float Voltage	13.7 V	13.7 V	13.7 V	13.7 V
Time until Float	3 hr	3 hr	3 hr	3 hr
Equalize Voltage	N/A	N/A	14.5 V	14.9 V
Equalize Duration	N/A	N/A	3 hrs	3 hrs
Equalize Calendar	N/A	N/A	28 days	28 days
Max. Regulation Voltage[1]	15 V / 30 V			
Low Voltage Disconnect[2]	11.5 V / 11.0 V			
Low Voltage Reconnect[2]	12.6 V / 12.1 V			

[1] Not temperature compensated. 15 V @ 12 V nominal, 30 V @ 24 V nominal
[2] Adjustable by switch, not temperature compensated. 11.0 V / 12.1 V setting can be modified in custom settings.

NOTE: Temperature compensation increases regulation voltage in cold temperature. A 15 V (30 V @ 24 V nominal) maximum battery voltage limit prevents damage to sensitive DC loads.

Environmental

Ambient Temperature Range	-40°C to +60°C
Storage temperature	-55°C to +100°C
Humidity	100% N.C.
Enclosure	IP10 (indoor)

Mechanical

Power terminals wire size (max.)	
Solid	#6 AWG / 16 mm2
Multistrand	#6 AWG / 16 mm2
Fine strand	#8 AWG / 10 mm2
Terminal Diameter	0.210 in / 5.4 mm
Power terminals torque (max.)	35 in-lb / 4 Nm
RTS terminals wire size (max.)	
Wire gauge (min)	#22 AWG / 0.3 mm2
Wire gauge (max)	#12 AWG / 3.0 mm2
RTS terminals torque (max.)	0.4 Nm / 3.5 in-lb
Dimensions	see inside front cover
Weight	1.3 lbs / 0.60 kg

Efficiency and Deratings

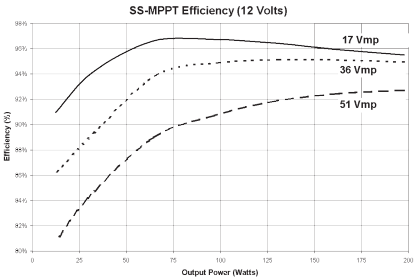

Figure 10. SS-MPPT 12 Volt Efficiency Curves

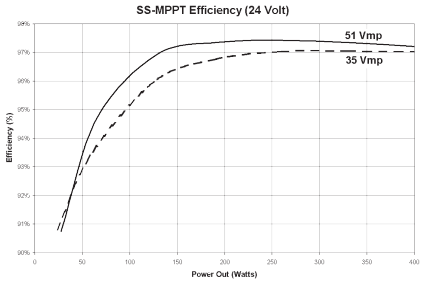

Figure 11. SS-MPPT 24 Volt Efficiency Curves

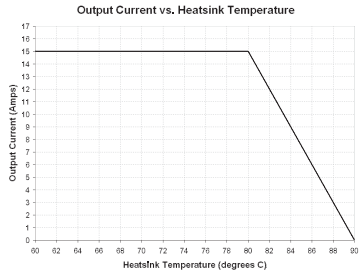

Figure 12. Output Current vs. Heatsink Temperature

7.0

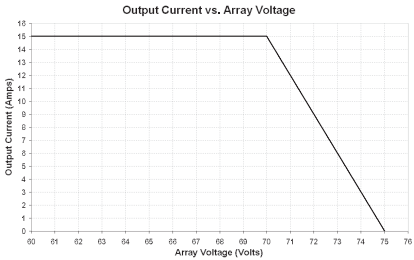

Figure 13. Output Current vs. Array Voltage

Specifications subject to change without notice.
Designed in the U.S.A.
Assembled in Taiwan

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MS-ZMAN-SSPPT-A
v02

Appendix A - Wire Charts

12 Volt Nominal Wire Chart

amps	One-way Wire Distance (feet) Wire Gauge (AWG)					One-way Wire Distance (meters) Wire Gauge (mm^2)				
	14	12	10	8	6	2.0	3.0	5.0	8.0	13.0
2	70	112	180	287	456	21	34	55	87	139
4	35	56	90	143	228	11	17	27	44	69
8	18	28	45	72	114	5	8	14	22	35
12	12	19	30	48	76	4	6	9	15	23
15	9	15	24	38	61	3	5	7	12	19

3% Voltage drop, Annealed copper wire at 20°C

24 Volt Nominal Wire Chart

amps	One-way Wire Distance (feet) Wire Gauge (AWG)					One-way Wire Distance (meters) Wire Gauge (mm^2)				
	14	12	10	8	6	2.0	3.0	5.0	8.0	13.0
2	140	224	360	574	912	43	68	110	175	278
4	70	112	180	286	456	21	34	55	87	139
8	36	56	90	144	228	11	17	27	44	69
12	24	38	60	96	152	7	12	18.3	29	46
15	18	30	48	76	122	5	9	15	23	37

3% Voltage drop, Annealed copper wire at 20°C

36 Volt Nominal Wire Chart

amps	One-way Wire Distance (feet) Wire Gauge (AWG)					One-way Wire Distance (meters) Wire Gauge (mm^2)				
	14	12	10	8	6	2.0	3.0	5.0	8.0	13.0
2	210	336	540	861	1368	64	102	165	262	417
4	105	168	270	429	684	32	51	82	131	208
8	54	84	135	216	342	16	26	41	66	104
12	36	57	90	144	228	11	17	27	44	69
15	27	45	72	114	183	8	14	22	35	56

3% Voltage drop, Annealed copper wire at 20°C